COMPARATIVE ANALYSIS OF ORGANIC AND NON-ORGANIC FARMING SYSTEMS:
A CRITICAL ASSESSMENT OF FARM PROFITABILITY

By

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Rome, June 2009
Acknowledgments

First and foremost I would like to thank my supervisor, Nadia El-Hage Scialabba, Natural Resources Management and Environment Department, FAO, for the tireless guidance, ideas, contributions and moral support during the process of writing this paper. Her professional and personal help, openness, energizing character made my stay at FAO and the research for this paper an unforgettable and very enriching experience. Moreover, special thanks to those who reviewed and provided valuable comments on this paper including Jamie Morrison (FAO), Cora Dankers (FAO), Sabine Zikeli (University of Hohenheim) and from the Johann Heinrich von Thünen Institute Hiltrud Nieberg, Frank Offermann and Jürg Sanders. Last but not least I would like to thank to the German Heinrich-Böll-Stiftung for their financial support during my stay in Rome.
Executive summary

The last decades have seen a proliferation of economic studies that have compared the economic performance of organic and non-organic farming systems. Several criticisms were formulated questioning the validity of such comparisons, partly because of the inherent difference between the two systems (in terms of complexity, diversity and objectives other than yield maximalisation), and partly due to the difficulty in excluding ‘non-system’ determined factors that also have an influence on profitability. Furthermore, the adequate selection of a reference group for comparisons has proved to be fundamental for relative profitability: which organic farms are put on the profit measuring scale by researchers with which conventional farms determine the outcome.

The list of profitability studies compiled in this paper involve more than 50 different cases, mostly from U.S.A, where several universities started long-term experimental field studies in the eighties and from European countries. Just over a dozen shorter-term studies have been collected from developing countries on high-value export crops. Most studies have used a case-study approach selecting between five up to hundreds of farms for the collection of data on farm economics.

The following main conclusions are evidenced by analysing the studies listed in the Appendix:

- The overwhelming majority of cases show that organic farms are more economically profitable, despite of frequent yield decrease;
- Organic crop yields are higher in cases of bio-physical stress (e.g. drought);
- The higher outcomes generated by organic agriculture are due to premium prices and predominantly lower production costs;
- The different value and accountability given to labour costs, including both hired and family labour, differs through countries, thus yielding to opposite results;
- The major difference in the profitability of the two systems is very often determined by the different management skills of the farmers thus, accounting for these seem to be fundamental for correct interpretations of results;
- There is a wide range of discrepancies among studies related to what variable and fixed costs entail and without agreeing upon which input costs shall be included under which circumstances in economic studies, no clear-cut conclusion on profitability can be drawn when analysing available literature.

Nevertheless, the analysis of the compiled studies demonstrates that, in the majority of cases, organic systems are more profitable than non-organic systems. There are wide variations among yields and production costs, but either higher market price and premiums, or lower production costs, or the combination of these two generally result in higher relative profit in organic agriculture in developed countries. The same conclusion can be drawn from studies in developing countries but there, higher yields combined with high premiums are the underlying cause for higher relative profitability.

Finally, this paper draws attention to the fact that existing economic comparisons are heavily biased because they do not internalize externalities neither account for the the fact that non-organic farms receive higher governmental support and better research and extension services. This paper argues that the profitability of a farming system must balance economic costs against environmental, social and health costs, as these costs have delayed impacts and indirect implications on farm economics.
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Appendix: 54 studies (in attached Excel sheet)
1. INTRODUCTION

Organic agriculture has triggered a controversial debate in the last decades, most importantly because it shed light on the darker sides of chemical-intensive conventional farming by offering an alternative. By now, there is a strong body of evidence showing that organic farming is more environmentally friendly: potential benefits from organic production arise from improved soil fertility, organic matter content and biological activity; better soil structure and reduced susceptibility to erosion; reduced pollution from nutrient leaching and pesticides; and improved plant and animal biodiversity (Kasperczyk and Knickel, 2006).

As more and more attention has been put on determining whether organic systems are environmentally better or not, it is not clear whether organic agriculture could be economically attractive enough to trigger wide spread adoption. If organic farming offered a better environmental quality, and potentially healthier foods, but not sufficient economic returns to the majority of farmers, it would obviously remain a luxury way of food production available to a very tiny fraction of farmers. However, the continued growth of organically managed lands worldwide, especially in developing countries, does not support this hypothesis.

The number of studies devoted to the question of how profitable organic agriculture is when compared to non-organic management is over hundred; however long-term studies analyzing the development of profits in comparative studies are much less numerous. Regrettably, the geographical distribution of these studies is very much biased towards developed countries (mainly U.S.A) and certain cash crops (e.g. corn, soy, wheat). Still, a general trend can be identified when considering economic comparisons made in the last three decades.

The aim of this paper is to analyze existing literature on the economic performance of organic versus conventional (defined as non-organic) farms, to determine the critical factors for success in the evaluation of organic agriculture in different socio-political settings, and to offer some critical insights into how comparative studies differ. Only studies using data from certified organic farms have been considered, covering a minimum of three years (for developed countries) after conversion and undertaken after 1980 (see Appendix). Due to the lack of availability of long-term economic studies in developing countries, the minimum length requirement was not taken rigidly and studies covering one and two years have also been included from these countries. Studies evaluating yields and certain production costs, but not analyzing profits were not considered. Although an effort was made to compile as many available economic studies as possible, the list in the Appendix is not exhaustive.

2. ANALYSIS OF PROFITABILITY STUDIES

2.1. Scope of profitability

2.1.1. Problems in defining farm profitability

The different meanings of profitability could be as numerous as the number of researchers conducting studies on profitability. ‘Profit’ is generally one of the most common and accepted indicators for the success of an economic activity (Offermann and Nieberg, 2000). However, the definitions for ‘profit’ differ between countries and studies, which make the comparability of profitability calculations between countries even more challenging. The meaning of profitability, as well as the different methodologies used for such studies, vary according to the different objectives of these studies. The objective of profitability studies could either seek to inform farmers on the consequences of choosing organic management (farm profitability), or seek to inform policy makers on the advantages of spending more on organic research (system profitability).
Besides the differing definitions related to different objectives of studies, there are other reasons that complicate the task of comparing economic studies across space and time, including: different costs of living and purchasing power; different interpretations of labour costs; changing economic and political environment, etc. Moreover, methodological choice, the time period analyzed and the selection procedure for comparable conventional farms considerably influence the results with respect to profitability. Similarly, extent of the economic assessment can be different in studies, resulting in different outcomes, with some studies focusing merely on the farm level, while others broaden the picture to the level of society. Depending on this choice, opportunity costs and externalities can be included (society level) or excluded (farm level). For instance some negative off-farm effects - like nitrate leaching - have no effect on the farm operation as such.

Profitability (defined as the level of farm profits) must be distinguished from relative profitability of an organic farm, which refers to the changes in the relation of agricultural income of organic farms to the agricultural income of non-organic farms. Differences in prices, yields, production costs, direct payments and non-agricultural outputs are identified as the main determinants of the relative profitability of organic farms (Sanders, 2007).

Moreover, when looking at profitability studies, correct interpretations of data is crucial. Overall comparisons cannot be made: between case studies and field experiments; between developed and developing country results; and between studies with very good data base and studies based on farmers’ opinions.

### 2.1.2. Determinants of farm profitability

The determinants of organic profits are in general very similar to those in conventional farming; only their relative importance may vary. Obviously for the whole farm performance, yields, prices and costs matter most in the calculations, but those are influenced by the following main determinants of profitability:

- **Agricultural policy environment**: the economic performance is in most developed countries significantly influenced by the support payments for organic farming, which is not the case in developing countries where government support is lacking for organic farms (though the compiled studies still showed higher profitability in the absence of government support). In the studies analyzed by Offermann and Nieberg (2000), these payments on average contributed to 16-24 percent of profits in Germany, Austria, Switzerland and Denmark. The 2003 CAP reform changed substantially the policy environment for organic and conventional farms. Similarly, the resumed Doha negotiations in 2007 aiming at agriculture liberalization policies are also expected to change the relative profitability of organic farming (Sanders, 2007).

- **Market environment**: an important aspect of the profitability of organic farms is the opportunity of receiving higher farm gate prices for organically produced goods than for conventionally produced ones. Prices vary between the different marketing channels and the quantities marketed via these sales channels. Organic farm gate prices also have to take into account part of the production that may be sold at conventional prices. Data from Great Britain and Germany showed that higher prices for organic products accounted for 40-73 percent of profits for arable farms, and 10-48 percent for dairy farms (Offermann and Nieberg, 2000). The incentive effect of market situation and organic prices are generally higher than of support payments (Offermann and Nieberg, 2009). In developing countries, for instance, where policy support does not exist, organic farmers are driven by the market opportunities of the North.

- **Political environment**: the market environment is very often influenced by political factors (and *vice versa*). For instance, accession to EU has led to a sharp decline of conventional producer prices: in combination with the support for organic farming according to EC Regulation 2078/92, this increased the relative competitiveness of organic farming (Offermann and Nieberg, 2000) in Austria, Finland and Sweden upon their accession.
- Farmers’ management abilities: although hardly measured in economic studies, farmers’ experience and decision-making abilities are one of the most crucial determinants for profitability. Farm success is often more dependent on the management ability of farmers, especially in the area of marketing, than on site-specific conditions.

### 2.1.3. Profitability and time lines

Inter-temporal comparisons of economic performance is very difficult for several reasons:

- The same sample of farms can hardly be used for comparisons over a long period. For instance, the samples in the EU farm accountancy data network (FADN) – which is a source of data on European organic farming’s financial performance – are changing over the years: some farms drop from the survey while others are taken up (Offermann and Lampkin, 2005). The development of average results therefore provides an insight into the average income situation of the current sample - changes in the situation however cannot easily be attributed to changes in the political or market environment as they could also be due to the changes in the samples (Offermann and Lampkin, 2005).

- Moreover, the criteria and procedure to select the conventional reference groups for the samples can and has changed during time (as in case of the EU FADN samples).

- Also, socio-economic parameters are constantly changing, influencing the determinants of profitability over time. For instance, price premiums change from year to year and their relative importance for the profitability of organic farming may decline under more liberalized market conditions, as was shown by Sanders et al. (2008).

- The importance of sales channels can also change over time. This can be due to different reasons as pointed out by Offermann and Nieberg (2000), including: establishing special organic sales channels may take several years; changing market structure, such as wholesalers entering the organic market; the quantities sold in direct marketing are generally limited. Older data on farm gate prices is even scarcer than recent data, and an analysis of time series of prices is further complicated by the price differences in the different marketing channels.

There are few available long-term observations of profits for organic and comparable conventional farms showing the changing trend in profits over several years; the ones in Germany and Switzerland done in the nineties for 8 and 7 years respectively, showed that variations in profits were similar for the two farming systems (Offermann and Nieberg, 2000). These almost-parallel profit curves (with the organic-curve constantly showing higher profits) were thus similarly shaped by external factors like climate, policies and prices. The overall comparison of the last three decades is even more difficult bearing in mind the political, economic and social changes throughout this period. Different policy frameworks were developed in the eighties than during the last years. Similarly, the weight of organic agriculture in global production has substantially changed. Neither premiums nor any policy support were yet available in the eighties and research was negligible as to providing higher-yielding organic varieties.

From this, it would follow that the profitability of organic could only increase with premiums, increased governmental support and higher yields, yet the long-term studies analyzed here did not interpret the underlying reasons for changes in relative profitability over the years. Looking for trends in relative profitability was thus beyond the scope of this paper, however the rationale behind changing relative profitability between organic and conventional systems would certainly merit further research. This being said, one should be cautious when comparing studies across time and space, since different political, social and economic conditions can lead to opposite outcomes.

### 2.2. Case study methodologies

In the Appendix, 54 studies are presented according to different crops (e.g. corn, soy, wheat, vegetables, fruits, livestock, coffee, rice, tea and cotton) and mixed systems, and according to studies made in developed countries (i.e. USA, Canada, EU countries, Australia, New Zealand) and developing countries (i.e. India, China, Philippines, Laos, Uganda, Mexico, Guatemala, Costa Rica).
The compiled list include case studies as well as field experiments and model calculations based on farm data.

The work undertaken for this paper considered the studies featured in the Appendix, as well as other studies that were not included in the Appendix for the following reasons: studies of less than 3 years were not retained for developing countries; studies focusing mainly on the period of conversion to organic management; studies comparing sustainable (i.e. not certified organic) and conventional systems. Although such studies were excluded for comparative purposes from this paper, they offered important insights for the critical assessment adopted for this paper. One one-year study was included as exception in the Appendix from a developed country (McBride and Greene, 2008), due to its large scale focus, involving more than 2200 farms from 19 states in U.S.A.

Most studies compiled were based on the approach of real farm comparisons, although the majority of those from U.S.A were conducted on experimental fields. The selection of a reference group for comparisons has proved to be fundamental for relative profitability, thus the decision about what to compare with what becomes of crucial importance. Yet, not always the most suitable comparisons were found, for instance, Canavari et al. (2007) and McBride and Greene (2008) used very different number of samples in both groups, Chase et al. (2008) compared three rotations, all from different years without specifying the basis of comparison. Similarly hard to draw far-reaching conclusions when the sample size is very small (e.g. Wynen (2001) used 5 pair comparisons) or when the exact years for comparisons are not given (e.g. Hirschi (2000) calculated a higher net revenue for organic, but was not clear which years were used as basis of economic comparison).

<table>
<thead>
<tr>
<th>Main criteria for economic comparison used by different authors</th>
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<tbody>
<tr>
<td>o Geographical proximity: Reganold et al., 1993; Dobbs and Smolik, 1996; Canavari et al., 2007;</td>
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<tr>
<td>o Physical similarities, such as size, soil and farm type: Dobbs and Smolik, 1996; Wynen, 2001; Canavari et al., 2007;</td>
</tr>
<tr>
<td>o Managerial similarity, such as experience: Mendoza, 2002; and management skills, e.g. Wynen, 2001;</td>
</tr>
<tr>
<td>o Cropping type similarity, such as mixed farms with livestock: FAT, 1993; Dobbs and Smolik, 1996.</td>
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Besides comparing the two production systems, several studies included the comparison of different management strategies, or added another type of production system:

| o Two and four year rotations were compared both in organic and conventional systems (Clark et al., 1999; Olson and Mahoney, 1999); |
| o Continuous cropping system of different crops and several rotations were compared (Helmers et al., 1986; Chavas, Posner and Hedtcke, 2009); |
| o Row crops and small grains were compared in organic, conventional and minimum tillage systems (Smolik et al., 1995); |
| o Organic, conventional and low-input systems were compared (Mazzoncini et al., 2000; Chase et al., 2008); |
| o Organic contract farming versus non-contract conventional farming was compared in one study (Setboonsarng, 2008) - it was not clear whether contract farming itself, or the organic system was responsible for higher profits. |

2.3. Yields

Evidence from the studies analyzed showed that yields in well-established organic farms are most often lower than conventional, to varying degrees. Most European studies including cereals, vegetables and mixed farming systems produced somewhat lower yields (FAT, 1992-97; BMELF, 1991-98; Offermann and Nieberg, 2000), whereas milk yields most often showed similar results when measured in liters per cow (Younie et al., 1990; FAT, 1993; Offermann and Nieberg, 2000). On the other hand, the majority of long-term studies involving soy-corn rotation in U.S.A, showed that organic yields on average were not significantly different (Chase and Duffy, 1991; Hanson et al.,...
1997; Drinkwater et al., 1998; Delate et al., 2002; Pimentel et al., 2005). Despite of lower soy yields in some other U.S. studies (Mahoney et al., 2004; Chase et al., 2008; McBride and Greene, 2008) high premiums (McBride and Greene, 2008) or lower production costs (Mahoney et al., 2004; Chase et al., 2008) rendered all organic systems more profitable.

Several of the U.S. studies investigated drier areas as well and found higher organic yields (Stanhill, 1990; Diebel et al., 1995; Dobbs and Smolik, 1996; Hanson et al., 1997; Pimentel et al., 2005.), suggesting that organic systems are more resistant to drought. Similarly, studies in developing countries showed that organic yields were generally higher under normal or favourable conditions (IFAD, 2003; Raj et al., 2005; Gibbon and Bolwig, 2007; Setboonsarng et al., 2008), but significantly higher under less favourable conditions (Mendoza, 2002). Overall, the majority of economic studies from developing countries showed higher yields for organic production, whereas not one study from developed countries showed increased yields when compared to conventional.

Examples of cotton yield increases in India
A study conducted by IWMI in 2003 in India showed that organic cotton yields were somewhat higher than in conventional farms (Shah et al., 2005). A 13 percent increase of yield was found in another organic cotton project in Andhra Pradesh by Raj et al. in 2005. Similarly, the Central Institute of Cotton Research in Nagpur found that organic treatment resulted in 11-21 percent higher yields (Eyhorn et al., 2005). Another study by Jackson (2005) found that organic cotton yields in Kutch were on average 2.5-2.75 t/ha, similar to or even in excess of those obtained under non-organic systems, and much more than irrigated conventional hybrid cotton yields in other states, such as Punjab and Andhra Pradesh. Factors explaining these differences lie in low pest populations due to dry climate, the widespread use of Desi varieties and greater attention paid to soil fertility.

Some difficulties arise when analyzing yields of the compiled comparative studies:
- Object of comparison (commodity or whole farm based?): some authors only look at yields of one or two cash-crops separately (Chase and Duffy, 1991; Dobbs and Smolik, 1996; studies from developing countries), whereas others also evaluate average yields of the whole rotation (Hanson et al., 1997; Chase et al., 2008) and of intercrops (Eyhorn et al., 2005) - the later is more relevant, although more complex for meaningful results;
- Unit of comparison (per ha or product?): some evaluate cow performance on a hectare basis (which is usually lower in organic, due to lower stocking densities), others per animal basis (which often yield equal results), and this makes comparisons difficult;
- Different varieties: varieties bred for intensive-external input conditions are hardly suitable in low-external input systems. Organic systems especially in developing countries often use local breeds and varieties which have lower yields but which are more adapted to low-external input conditions (require less nutrients and water inputs or have higher pest/disease resistance) and authors do not specify that differences in yields may come from different varieties;
- Different growth periods: using different varieties also influence the economics of the whole rotation: for example, many organic farmers use Desi cotton, which is a whole-season crop, thus after harvest farmers cannot grow anything else in the rotation. Most conventional farmers grow hybrid varieties under irrigation, which enables the growth of two or three crops per year (Jackson, 2005);
- Managerial background: the previous intensity of conventional management very much determines the yield decreases during and after conversion to organic and often the background of organic farms are not clear from the studies, although it influences the comparative baseline.

Farmers’ background influences yield performance
The increase or decrease in yields with the conversion to organic is not a universal phenomenon, but depends on how crops have been produced conventionally, as well as other factors such as soils, climatic conditions, etc. For instance, Birzer and Badgery (2006) found in a survey of organic wheat farmers across five Australian states that farmers who produced conventionally before noted a decline in yields, however after the fourth year yields showed improvements; whereas farmers who already used mainly organic methods did not see a drop in yields. Similarly, several studies in developing countries showed that where small farmers have little access to agrochemicals, the conversion from conventional to organic usually represented an increase in yield from 15 percent (Bray et al., 2001) to 50 percent (IFAD, 2003) in Mexico and 67 percent in Guatemala (Damiani, 2002).
When converting to organic agriculture, a change in paradigm shift must take place from the external input packages that treat problems to the preventive management and intensive knowledge inputs. Yields are not a characteristic of a production system per se, but very much dependent on farm management. Although organic produce is generally yielding less, yield losses can be mitigated to a certain extent by proper soil management, shade trees (such in coffee), timely removal of diseased plants, and a healthy balance between pests and natural enemies as biological controls (Van der Vossen, 2005). Nevertheless, although an important element for profitability, yields alone do not indicate profitability.

2.4. Production costs

There is a wide difference among authors in how to aggregate production costs. Total costs include:

- operating/variable costs: all production practices including planting, pest and weed management, harvesting, etc.;
- cash overhead: land rental, property taxes, etc; and
- non-cash costs: depreciation and opportunity costs for equipment, irrigations systems, tools and buildings.

In economics, fixed costs are business expenses that are not dependent on the activities of the business. They tend to be time-related, such as salaries or rents; by contrast, variable costs are volume-related (Sullivan and Sheffrin, 2003). In farm economics, there is no absolute definition of what has to be considered as variable costs or as fixed costs; it depends on the aim of the research. Some studies take only variable costs into account to calculate gross margins (Younie, 1990), others include fixed costs in their studies (Wynen, 2001; Gibbon and Bolwig, 2007) and yet others do not differentiate between variable and fixed costs (Olson and Mahoney, 1999; Delate et al., 2002). By definition, fixed costs are part of the total farm costs that do not vary significantly with the volume of output and that can only be changed in the long run, whereas variable costs are those that vary directly with the volume of output. The differentiation between variable and fixed costs is actually only important when gross margins are calculated since for those, fixed costs are not accounted for. However, fixed costs are crucial for farm profitability: for conversion for instance, several substantial investments have to be made (e.g. new animal friendly housing system, new orchard varieties to better withstand bio-physical stress) that are often counted as fixed costs and for many farmers, these costs actually define whether converting to organic may be profitable or not. Even though most studies make the distinction between the two types of costs, they may not specify exactly what costs are included among them. Mentioning merely variable and fixed costs does not allow the appreciation of the variables used and thus, proper comparisons.

An even more complicated issue is the inclusion of labour costs: some comparisons omit labour costs from the whole calculation of net revenues (e.g. Hanson et al., 1997; Delate et al., 2002), while most include hired labour as variable costs (Wynen, 2001; Eyhorn et al., 2005; Gibbon and Bolwig, 2007; Chase et al., 2008); some account for (hired) labour costs as fixed costs thus leaving them out from gross margin results (FAT, 1993; BMELF, 1994); and yet others count family labour as opportunity costs or leave them out completely (as most studies do in developing countries). Yet, another approach is used by Wynen (2001), who included hired labour as variable and family labour as fixed cost. Very often in developing countries, only cash costs are included and non-cash costs (like own labour and seed) are excluded (Setboonsarng et al., 2008). Whether labour costs are treated under fixed and/or variable costs, the most important is that they are treated consistently within the case study and are not overlooked.

Another challenge is the economic analysis of livestock operations, since sometimes they are handled on their own without taking the interactions between animals and the cropping systems into account. For instance, Younie et al. (1990) calculated gross margins with including categories on the costs side like purchased feeds, forage and other; similarly the FAT investigations (1993) in Switzerland took mostly concentrates, veterinary and medicinal costs into account, and thus left all costs related to the on-farm feed/manure production out of the calculation. Moreover, reduced expenditure on synthetic...
chemicals for forage production further lowers production costs in organic agriculture: however, this later is also not included in livestock comparisons.

From this, it follows those overall conclusions about production costs cannot be drawn from the economic studies compiled. Even if cost elements would be standardized, variations among production costs would occur due to the unique character of the operations and factors outside the control of the farmers: machinery costs depend also on the age, size and usage of equipments; irrigation costs are subject to variations in rainfall, temperature and efficiency of irrigation systems; and labour costs depend on wage rates, working conditions and efficiency of workers.

This being said, production costs tend to be lower in established organic systems, as most of the cases elaborating on input costs showed (e.g. Helmers et al., 1986; Hanson et al., 1997; Olson and Mahoney, 1999; Delate et al, 2002; Mendoza, 2002; Eyhorn et al., 2005). In most European studies analyzed by Offermann and Nieberg in 2000, total costs of organic farms were on average slightly lower than on comparable conventional farms: while variable costs were generally significantly lower (60-70 percent), fixed costs were up to 45 percent higher than those of the conventional reference group in several countries. The few cases with significantly higher production costs were the ones focusing on vegetable production or the ones done in developing countries.

It has to be noted here that all analyzed studies relied on relatively cheap input costs (based on cheap fossil fuel) that have been varying tremendously the last year. Input costs are bound to increase on the long run: global nitrogen fertilizer prices surged by 160 percent during the first quarter of 2008 and although oil prices have deflated during the second half of 2008, fossil fuel based agricultural inputs (a substantial part of production costs) will sooner or later substantially affect conventional systems that rely on the intensive use of synthetic fertilizers and pesticides. In the case of organic agriculture, oil-based inputs negatively affect product costs where plastic mulch is used and more generally, when the system is mechanized.

2.4.1. Variable costs

It is important to understand the differences between organic and conventional systems in a given agro-climatic region in order to consider all relevant variable costs. For instance, weed control in organic agriculture may include manual pick-up or mechanical tillage, plastic mulching and flaming: these costs will not be captured if only herbicide costs are accounted for. Similarly, using transplants (e.g. tomatoes) in organic agriculture but not in conventional systems raises variable costs for organic, so do cover crops, purchased composted manure, legumes, green manure and labour for hand and hoeing costs. These are different costs than what a conventional system may entail with the dominance of fertilizer and pesticide costs.

Generally, variable costs include:

- ploughing and tillage,
- seeds and transplants,
- fertilizers, manure, mulch,
- pesticides, herbicides,
- energy, fuel,
- labour (operator labour, regular and seasonal hired labour),
- machine repair and maintenance,
- renting equipment,
- cold storage,
- transport,
- variable irrigation expenses,
- other materials (e.g. packing containers for fruits),
- record keeping and,
- certification costs.
Additionally, livestock productions include costs related to feed, health, bedding and breeding herd. Besides these, some studies included post-harvest handling and processing activities (Gibbon and Bolwig, 2007) and crop insurance, miscellaneous, pre-harvest interest expense (Chase et al., 2008) as variable costs.

As previously said, costs like machinery and labour, are sometimes treated as fixed costs in some studies (FAT, 1993; BMELF, 1994). The explanation for this was that farm accounting systems did not allocate machinery costs to production enterprises but presented a summary of all machinery costs under fixed costs. Olson and Mahoney (1999) also grouped all machinery costs (fuel, maintenance, repairs, labour, overhead) together, whereas most studies made the division between depreciation of machinery and equipment as fixed cost and fuel as variable cost (e.g. Wynen, 2001). Moreover, Lampkin and Padel (1994) noted that expenditure on marketing, certification, costs of training and advice were also calculated under fixed costs in some studies. The authors concluded when analyzing dozens of economic studies that variable costs were typically 50-60 percent lower for organic cereals and legumes, 10-20 percent lower for potatoes and horticultural crops and 20-25 percent lower for dairy cows. On the other hand, few studies showed that higher costs were due to the purchase of composts and other organic fertilizers. Higher input costs can also result from the use of transplants (Clark et al., 1999; Brumfield et al., 2000), labour for hand weeding and harvesting, and higher level of packaging, storing and processing (Gibbon and Bolwig, 2007).

2.4.2. Fixed costs

Fixed costs generally include:

- purchase and rental of land,
- land charges and administrative costs,
- interest on farm-related loans, and
- replacement values of machines including depreciation, interest and insurance.

Again, there was a wide difference in the analyzed studies as to what was included under fixed costs: Gibbon and Bolwig (2007) took the purchase and transport of planting materials, long-term fertilization costs, scheme membership costs into account; Wynen (2001) listed family labour; and the German study by BMELF (1991-98) considered all labour and machinery costs as fixed costs. Some studies also added the annualized cost of past investments, where these were still utilized. Overall, fixed costs generally account for the smaller part of total production costs (except for when labour and machinery costs are treated as fixed costs), therefore these costs are important but not decisive for determining farm profitability.

2.5. Gross margins and net returns

Most studies use net income/returns per hectare as a measure of profitability. Net returns are calculated by subtracting total costs from gross revenues. Gross revenues are the average yields per hectare multiplied by the commodity farm-gate price. Other studies use gross margins to measure economic performance; gross margins are calculated by subtracting variable costs from the total farm income.

Critiques of the use of gross margins

Farmers in Europe, Australia and New Zealand use mostly gross margins and thus leave-out fixed costs from the calculus due to the different levels of debt servicing, ownership structure and other fixed costs. Several critiques were formulated by Lampkin and Padel (1994) related to gross margins:

- farms receiving higher prices through better marketing showed in their gross margins the higher price, however the related costs of processing, storage and marketing was often left out;
- no information is given on labour inputs (in the case where labour was considered as fixed cost);
- conventional variable costs (i.e. fertilizer, herbicides) can be substituted by fixed costs in organic, such as machinery, labour and other tools, such as plastic mulch.
Most studies from Europe and Canada reported similar or higher gross margins for organic, but besides lower costs, higher prices were required to compensate for reduced yields. In several cases (Younie et al., 1990; FAT, 1992-97; BMELF, 1991-98) lower variable costs resulted in similar or higher gross margins. Similarly, where premiums were available and the proportion of higher-value crops such as vegetables were bigger, gross margins were higher (BMELF, 1991-98).

**Main reasons for higher profitability of organic systems**

- Higher market prices and premiums: even with less yields and higher production costs, organic remained more profitable due to 400 percent higher market price (Younie, 1990; IFAD, 2005); even with much higher costs and significantly lower yields, price premium made organic more profitable (Brumfield et al., 2000; Lyngboek et al., 2001; McBride and Greene, 2008); higher prices for organic accounted for 40-75 percent of profits in Germany and Britain for arable farms, and 10-48 percent for dairy farms (Offermann and Nieberg, 2000);
- Lower production costs: lower production costs caused significant difference in net returns even without premiums (Mendoza, 2002; Mahoney et al., 2004);
- Combination of premiums and lower production costs: low production cost along with the 20 percent premium on organic was the prime reasons for higher profit margin (Shah et al., 2005);
- Combination of higher yields and premiums: IFAD, 2003; Gibbon and Bolwig, 2007; Setboonsarng, 2008.
- Combination of higher yields and premiums and lower production costs: Jalees, 2008.

Net returns which take total costs into account most often proved to be higher in organic systems. Overall, reduced costs and/or higher market prices and premiums were given as main explanations for higher profits on organic farms. Yet, in several studies, the organic rotations profited equally or better even without premiums (Diebel et al., 1995; Smolik et al., 1995; Dobbs and Smolik, 1996; Hanson et al., 1997; Olson and Mahoney, 1999; Hirschi, 2000; Delate et al., 2002; Eyhorn et al., 2005; Pimentel et al., 2005).

Although yields in organic systems tend to be lower, input costs are usually lower, making these systems competitive with conventional systems, sometimes even before including organic price premiums. Welsh (1999) reviewed six long-term studies in the Midwest: without premiums, in three of the studies the more diverse organic systems were as profitable as the conventional systems; with premiums, however, in all six studies the organic systems had higher net returns. Thereafter, Mahoney et al. (2004) found in south-western Minnesota that a four-phase organic rotation (corn-soybean-oat-alfalfa) had equal net returns to a two-phase conventional rotation (corn-soybean) even without price premiums. Similarly, Delate et al. (2003) had the same findings in Iowa. Pimentel et al. (2005) reported that in the Rodale study in Pennsylvania, a three-phase organic legume-based system had similar net returns as the conventional corn-soybean rotation, again before organic price premiums were factored in.

Nevertheless, the impact of the organic price premiums is large. In other studies, price premiums were needed to break even the conventional income (Helmers et al., 1986; Chase and Duffy, 1991; Brumfield, 2000; Lyngboek et al., 2001; McBride and Greene, 2008; Chavas et al., 2009). As Chavas, Posner and Hedtcke (2009) showed, when organic price premiums are included along with the government payment, returns to the organic grain system increased by 85 to 110 percent, and in the forage system by 35 to 40 percent, placing both of them with higher returns than any of the Midwestern standards of no-till corn-soybean, continuous corn, or intensive alfalfa production.

Thus, looking at the economic performance of over 50 studies, a common conclusion can be drawn that premium prices and/or lower variable costs most often compensate for reduced yields and give similar or higher net returns/gross margins.
2.6 Profitability in developing countries

In less developed countries, very few studies have been conducted on the profitability of organic agriculture and none used farm budget-related data. Long-term studies are hardly existent: only about a dozen studies compared both yields and net income, mostly focusing on coffee and cotton. There are several outstanding characteristics that make comparative studies in developing countries different from those in developed countries. Some of these differences are the following:

- Non-cash costs are often not taken into account (Mendoza, 2002): they are not treated as costs by farmers since it does not involve money on their part. Most farmers view their work as their main occupation, having no alternative off-farm source of income. Thus, opportunity costs for family labour are not considered, whereas they contribute to a substantial part of production costs as opportunity costs in developed countries.

- Many farmers are tenants and do not own the lands in developing countries, and as a consequence have less motivation in investing into better management practices. Mendoza (2002) found that all organic farmers were landowners (and indeed they had higher yields), whereas only three out of the studied 17 conventional rice farmers owned their lands.

- Livestock represents a critical element of organic farming in developing countries; animals are not only a source of manure, but also of farm power and immediate cash. Yet, most economic studies leave them out from the calculus of costs and revenues (Julees, 2008).

- Most studies in developing countries rely on interviews with farmers. Consequently, many of the responses may be based on perceptions rather than on well-kept records. In many areas, farmers are mostly illiterate, so they do not keep written accounts and find it difficult to recall earlier costs of different inputs. Thus, data in these studies are mostly approximate figures, giving a rather indicative idea of economic performance.

- Many studies in developing countries do not calculate fixed costs in a discounted form, since farmers are usually enable to recall exactly when and for how much they have made investments and how long those investments were to be utilized.

- Farmers most often cannot recall the scale and timing of earlier investments, neither can they estimate how long into the future current investments are utilized. For these reasons, calculation of fixed costs in a discounted form has not been attempted in most studies (e.g. Gibbon and Bolwig, 2007).

- Public support schemes, such as price support, provision of research extension and marketing services are non-existent. However, farmers who are members of contract farming schemes are entitled to free certification and training (Gibbon and Bolwig, 2007).

- Organic farmers have higher variable costs on post-harvest handling and processing activities in order to meet the higher quality standards set by the organic exporters.

All complied studies in developing countries showed higher profitability in organic agriculture (except for one study by Pülschen and Lutzeyer, 1993), partly because of higher yields and reduced costs (Mendoza, 2002; Eyhorn et al., 2005; Jalees, 2008), partly because of much higher market prices (IFAD, 2005). It is important to carefully consider the quality of organic farming data in developing countries, especially when studies are based on interviews with farmers: Mendoza (2002), Carpenter (2003), IFAD (2005), Jalees (2008).
Profitability of organic cotton production

An Indo-Swiss research team compared agronomic data of 60 organic and 60 conventional farms over two years (Eyhorn et al., 2005) and came to the conclusion that cotton-based organic farming is more profitable: variable production costs were 13-20 percent lower, inputs were 40 percent lower, yet yields were 4-6 percent higher in the two years, and as a consequence gross margins for cotton were also 30-43 percent higher. Although crops grown in rotation with cotton were sold without a price premium, organic farms achieved 10-20 percent higher incomes from conventional agriculture. Similarly, an impact assessment study for organic cotton farmers in Kutch and Surendranagar commissioned by Agrocel concluded that farmers who participated in the project enjoyed a net gain of 14-20 percent resulting from higher revenues and lower costs. The updated version of the study surveying 125 organic cotton farmers concluded that 95 percent of respondents saw their agricultural income risen since adopting organic agriculture, on average by 17 percent, most of them attributing this largely to the reduced cost of production and increase in cost of selling (MacDonald, 2008). Similarly, Raj et al. (2005) found in Andhra Pradesh that organic cotton was much more profitable, since conventional cotton did not have any profits (income was + $13 versus -$30). In conclusion, all studies found organic cotton farming more profitable than conventional.

3. CRITICAL QUESTIONS FOR COMPARATIVE STUDIES

3.1. What methodology is used?

Different studies use different methodologies and rely on different sets of data. The most common ones found in the compiled studies can be grouped in the three categories described below.

3.1.1. Experimental trials

The use of production data from university trials and research institutions database to estimate enterprise budgets (Helmers et al., 1986; Diebel et al., 1995; Smolik et al., 1995; Olson and Mahoney, 1999; Hirschi, 2000; Delate et al., 2002). These field studies use replicated in randomized blocks (Hanson et al., 1997), or compare different production regimes using adjacent parcels (Clark et al., 1999). While field studies allow for the exclusion of many external factors influencing profitability (and thus the effect of the production systems themselves on economic performance is more obvious), this methodology fails to consider land and labour charges on the costs side and real marketed quantities on the revenue side (not all organic harvest can be sold as organic at a premium price). Not all harvested produce could get premium price also because of the necessity to meet certain quality requirements – these aspects could only be covered by studies relying on data from existing farms. Yet the biggest problem with this approach is that it ignores the farmer as an entrepreneur since it keeps as many factors as possible constant (whereas farmers may change practices, such as rotation, as soon as prices change or certain problems arise). Nevertheless, several criteria could be used to improve experimental trials, such as: sufficiently large size; inclusion of human input; and several years’ comparison after the conversion period.

3.1.2. Farm operations

Direct comparison using data from operating farms, surveys or case studies is the most often preferred methodology for comparative studies. Obviously, the comparability increases with the number of selection criteria used. Farm surveys can take the shape of sample-groups, matched pairs and clustered groups and they use enterprise budgets. One critique of case studies and of surveys comparing individual organic farms with averaged group data for conventional farms is the inability of generalization, since individual farms cannot be considered representative of the population. Other surveys compare group averages for organic and conventional farms, but variations within the groups may be as large as as any difference between the groups. Case studies allow understanding of interrelationships and causality, at the expense of comparability and statistical analysis (Lampkin, 1994).
To assess the relative profitability of organic agriculture, one of the most crucial considerations is the selection of the comparison group. The German long-term study by BMELF between 1983-94 showed that if organic is compared to a carefully selected comparison group, than it receives higher profits, whereas if compared with ‘main income’ German farms, than organic profits are lower.

There are different approaches for selecting comparable conventional farms, both with respect to the choice of selection variables and to the applied matching procedures. Consequently, results between studies and countries cannot be easily compared. Attempts have been made to develop guidelines on the selection process for comparisons; Offermann and Lampkin (2005) have suggested to include farms with similar environmental conditions, localization, equipment of production factors, and farm type. Within the EU research project EU-CEE-OFP, guidelines for the harmonization of income comparisons of organic and conventional farms have been developed, which can serve as a basis for a ‘code of good practice’ (Offermann, 2004). The preferred approach is to select a group of similar conventional farms to compare with each individual organic farm, so that the impact of differences in management ability can be minimized (Offermann and Lampkin, 2005). If there is high number of organic farms present in a region, the comparison procedure becomes easier: specific matching is not needed anymore, as the organic farms can simply be compared to all conventional farms of similar farm type and same size in the respective region.

Comparisons can be made between: groups of similar farms; between two representative farms; between farms based on „minimum similar criterion”; or between farms with similar characteristics in production system, size and location (Cisilino and Madau, 2008). Sample size shall not be too small, otherwise it is hard to do any statistical tests of differences. Comparing a large-scale conventional farm with a smallholder organic would give radically different results compared to when sizes are similar. Due to economies of scale, large farmers are more likely to purchase seeds and chemicals for lower prices from wholesale outlets, by-passing local sales people. Furthermore, similar number of farms shall be chosen in both groups in order to have substantial homogeneity between organic and conventional farms as regards structural, environmental and managerial aspects. According to Offermann and Nieberg (2000), the advantage of this system is that it minimizes the risk of including „non-system determined” aspects that can affect the results, since both farm types show an average potential endowment 1.

Non-system determined factors – such as location, size, land tenure, land characteristics, financial circumstances, production, marketing and managerial influences (Dabbert, 1990) – are better to be ruled out if the intent is to assess the financial performance of different production systems. It is best to compare similar farm types (arable, dairy, mixed, etc.) with similar intensity of external input use under similar agro-ecosystem and socio-economic conditions. Yet, the risk of choosing non-similar systems will always remain, due to technological or management differences.

3.1.3. Modeling studies

The modeling comparisons of organic and conventional farms based on empirical (econometric) or normative models is rarely used. A USDA study (1980) and a study in Iowa (James, 1983) were one of the first modeling studies and both showed that organic agriculture had consistently lower returns. Although these models allowed for non-system determined factors to be excluded, they involved high level of abstraction and simplicity. The previous studies can be criticized for assuming that soil structure, infiltration rates, erosion rates were the same and these did not influence the economic outcome. Since there are significant differences between the two systems in terms of replacing needed nutrients and water, these costs will be manifested over time. Moreover, the diversity of crops on organic farms can provide economic benefits that are usually also not captured (e.g. resilience to

1 Several studies compared unequal number of farms: in Vermont, 7 organic and 182 conventional dairy farms were compared (McCrary, 2001); in Emilia-Romagna, Italy, comparison was made between 83 organic and 1781 conventional farms and in Minnesota between 42 organic and 2897 conventional (Canavari et al., 2007).
natural and economic shocks). Another example that such models do not necessarily reflect reality is the economic simulation model used by Diebel et al. (1995) that assumed equal yields.

3.2. What indicator is used for the comparison?

Net revenue or gross margin per hectare/acre is used most often as main indicator of profitability. The evaluation of results strongly depends on whether profits per family work unit are tested, which are usually equal to, or higher, in organic, or profits per hectare of utilizable agricultural area is tested, which is often lower than those of conventional farms (Offermann and Nieberg, 2000). Similarly, if the average market value of crops produced on farms is evaluated, conventional will most often outperform organic, due partly to differences in the relative amount of land devoted to each crop.

If one considers the indicators for yields, and yield per hectare of a single crop is measured, it would be probably lower in an organic farm than on a conventional growing mostly that crop. Whereas, if total production per hectare of all crops is taken into account, than organic may easily outperform conventional. Conventional systems focus on cultivating high-value crops in most areas, whereas organic farms have to limit high-value crop acreages for enabling rotation. Consequently, systems with a higher proportion of such crops (like soybean grown in a soy-corn rotation or tomatoes in a two-year conventional rotation) tend to have higher net returns (Helmers et al., 1996). Clark et al. (1999) concluded that the two-year conventional rotation was most profitable due to greater frequency of high-cash crop (tomato). However, the study showed that when high value crops were grown in a longer (conventional) rotation, organic rotation outperformed the conventional one.

3.3. Is organic treated as a whole system?

The concept of a farm as an independent system of which components are operating together for a common purpose, has been recognized for long (Lampkin and Padel, 1994). Organic agriculture specifically requires a systems approach due to its complexity. Conventional and organic farms represent different systems. Thus, the usual simplified approach of comparing them on the basis of few variables looking at few cash crops may not be sufficient. Let alone the negative off-farm implications of specialized conventional systems as opposed to organic ones aiming at semi-closed systems if we want to analyze profitability on the society scale.

Furthermore, evaluating the profitability of a single crop may is not appropriate in a whole-farm system, since it would disregard the interactions between farm elements. Organic cultivars are in many cases different and do yield less: for example, fertility enhancing legumes take at least 1-2 years in the rotation and bring less in direct cash than a high-yielding conventional cash crop. The same legumes may, however, double the yields of the subsequent cereal crop. Overall, a multi-disciplinary approach that involves the whole farm (including crop and livestock operations) and takes note of the management skills and objectives of the farmers is a more favourable option.

3.4. Are farmers’ objectives taken into account?

When measuring profitability, researchers cannot put aside farmers’ objectives. Maybe, some organic and for that matter conventional farms may not aim to the highest possible returns, but have other priorities, such as stress less lives in the countryside, production of healthy food, better family health, etc. Thus, even though an organic farmer could have a lower profit than the conventional counterpart, his/her main objectives could be met while still having a sufficient income for the family.

Dobbs and Smolik (1996) showed that organic farms still earned acceptable profits since net revenues were high enough to cover all costs, including land charges and family labour wages. Profitability is thus rather understood in the context of the farmers’ goals; excluding these from economic studies would require a very careful interpretation of results. If profitability of an organic farm is related to the profitability of a conventional farm, as is done in comparative studies, it is not clear whether the relative profitability of farms draws a valid picture of reality or distorts it. Farmers may for example
have other income sources that balance-out a less impressive profit, such as agritourism, eventual carbon sink payments or other off-farm activities. The question is whether farmer’s average profits over the years is satisfactory or not in relation to farmers’ set objectives. Another factor to be considered is indebtedness due to previous investments and the extent to which profits can enable the pay-back of loans. Such factors play an important role in determining farm profitability and could be captured through household surveys.

3.5. Are price premiums taken into account?

Farmers can receive premiums for various commodities thus, making organic agriculture more profitable. Premium prices for organic crops are widely available for most developed countries (and much less in developing ones), but the size of the premium varies among crops and countries. Not only that premiums vary but not all products may be sold at premium prices due to quality requirements (e.g. colour, size specifications) or lack of market demand. Thus, these would be sold as conventional. The importance of domestic organic markets and local demand is thus crucial in order to sell all produce with premiums and not just one proportion of a single export crop, according to trader’s specifications.

Premiums breaking even conventional profits

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<th>Premiums breaking even conventional profits</th>
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<td>Most studies in the eighties and early nineties by land-grant universities in U.S.A. did not take premiums into account (Diebel et al., 1995; Smolik et al., 1995). The Wallace Institute review of six midwestern university studies found that organic grain and soybean production systems earned higher profits with premiums, and even without them, half of the organic systems were more profitable. Welsh (1999) noted, when calculating the required premiums for some of the organic systems, that the greater the number of crops commanding premiums in the rotation, the smaller the size of the premiums required to break even, as compared to the conventional system. He calculated for the Minnesota experimental trials that, if premiums were available for all crops (i.e. corn, oats, alfalfa), a 19 percent premium/crop/year would be needed, whereas if only corn and oats got premiums, 35.4 percent was necessary to break even conventional profits.</td>
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Premiums depend on many factors – such as commodity, location, access to organic markets and marketing skills of the farmer – and can take several forms: constant, seasonal or for established amount of products per month\(^2\). In many cases, it is the premium price that makes organic systems more profitable. However, even without premiums, organic systems may be more profitable than conventional. With economy of scale in organic agriculture, premiums are less needed since post-harvest and certification costs are lower with greater quantities. Overall, omitting premium prices – when they are available – would run counter to economic realities. Yet, many studies warned that reliance on price premium may jeopardize the long-term economic viability of organic farming (Clark et al., 1997). Since the market for high-value crops can get saturated, and premiums can fall as a consequence, a strategy of diversification is advised in which lower premiums are given to all crops in the rotation.

3.6. Is governmental support taken into account?

Different payments are awarded to organic farms, depending also on the crops grown. It is important to take these into account to accurately show the relative profitability of the two systems. In most countries, existing governmental policies benefit organic agriculture much less than conventional ones (Smolik et al., 1995). Much is revealed on this aspect when researchers compared differences in economic profitability in relation to the presence or absence of government payments. Diebel et al. (1995) showed that without governmental payments, organic returns were 143 percent greater than conventional, yet if government payments were taken into account, the difference in favour of organic was ‘only’ 78 percent greater than conventional returns. In the EU, member states can support organic farming directly via agri-environmental measures. Offermann and Nieberg (2000) calculated that for

\(^2\) Larson, Kliebenstein and Honeyman (2002) explained that in the case of organic pork production, a constant premium encourages over-production of summer farrowed pigs (when costs are much less) and thus, a seasonal premium is much to be preferred to trigger production during winter periods.
organic farms in Austria, Denmark and Germany, the share of governmental payments in profits are at around 20 percent, whereas in Great Britain this share is much lower due to both the relatively low level of payments, and the fact that only converting farms are eligible for payments under the organic farming scheme.

3.7. Are differences in profitability caused by non-system differences?

When there is a difference between the two production systems, it is important to determine whether these differences are because of the system itself or due to external factors, such as management skills of farmers. Whether a farming system is financially beneficial depends also on what is included in the analysis: off-farm effects are very difficult to quantify, though they are extremely relevant for determining the efficiencies of a particular farming system.

Failure to choose the right comparison groups by accounting for the non-system determined factors may lead to the question whether these or the type of production system is responsible for differences in profitability. Many studies compare the profitability of organic versus conventional and treats results in different profits as arising from differences between the systems. Several others, however, conclude (Fox et al., 1991; Dobbs, 1994; Canavari et al., 2007) that the differences lay in other factors, such as variations in the production systems, climate, soil and crop types. It has to be observed that annual results on profitability of organic and conventional farms show similar variations, indicating that not necessarily the farming system per se but other factors—climate, soil type, input and output prices, premiums, policies and exchange rates all dependent on the particular country and on the time when farming takes place—determine the profitability of a farm (Wynen, 2006).

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<th>Different 'non-system' influences on farm profitability</th>
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<td>o <strong>Within-system variations</strong>: Welsh (1999) concluded that within-system variations (e.g. region, environment) had a greater effect on profits than between-system variation of organic and conventional. Similarly, Nieberg and Offermann (2002) came to the conclusion that the development of profits was comparable in organic and conventional farms and rather external, non-system factors influence on the two production systems in a very similar way. Also, Smith, Clapperton, and Blackshaw (2004), who conducted an analysis of organic and conventional crop rotations in the northern Great Plains of Canada, concluded that there was as much variation in net returns within organic and conventional systems as between the two.</td>
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<td>o <strong>Physical characteristics</strong>: Murphy (1992) reported that large differences in farm size, farm enterprise structure (i.e. proportion of land cropped), land quality and location often had a greater influence on income levels than the production system itself.</td>
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<td>o <strong>External factors</strong>: the parallel changes of conventional and organic profits in the German long-term study by BMELF between 1983-94 showed that the impact of external factors, such as climate and agricultural policy changes, was substantial.</td>
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<td>o <strong>Unmeasurable influence</strong>: Canavari et al. (2007) concluded that due to inaccessibility of individual data, the significance of differences could not be tested thus, it was not possible to prove whether income difference was system-related.</td>
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3.8. Are compared farms still in conversion?

Comparison between a conventional farm and an organic farm in conversion is unfair as often, organic conversion involves investment costs for adoptions to organic farming in terms of e.g. varieties for perennial crops, animal-friendly housing systems and adapted machinery. During conversion, organic farms cannot earn premiums and yield reduction is common, until farmers learn and adjust to organic farming practices and the equilibrium of the agro-ecosystem is restored. Throughout this period, financial loss can be severe: less profitable crop rotations may be required; yields may decrease due also to higher weed infestations; and normally, three or four years have to pass until crop rotations become established and yield begin to increase.
According to Dabbert and Madden’s (1986) model simulations, the rotational effect on income is not over till the sixth year, when the legumes begin to deliver their maximum contribution to the farm’s nitrogen supply. Wynen (2001) showed that organic farms that had been under organic management for longer times achieved higher yields than the latest entrants. Thus, this transitional phase is the most challenging one for organic farmers and should not be taken for the purpose of comparative studies with other conventional farms. It is, of course, another matter if the objective is to find out the change in farm economics during conversion. In such cases, one full crop rotation cycle, in addition to the conversion period of three years, is the recommended minimal period for conversion experiments (Standhill, 1990).

3.9. Are multi-year comparisons designed to include the whole organic rotation?

Studies covering only one year may be strongly impacted by certain climatic, economic or other factors prevailing in a given year. The weakness of several studies (especially of those with annual crops, where rotation is a must in organic) is their relatively short length. Organic rotations usually cover 3-4 years, whereas conventional ones are shorter. In order to accurately evaluate the profitability of organic farms, the whole rotation must be taken into account. Moreover, benefits of „rotation effects” manifest themselves usually several years after rotations so ideally, a multi-year comparisons should be designed for determining farm economics (Welsh, 1999). Soil quality tends to improve over time and weed, insect and disease populations decrease in the organic system with good management, thus lowering nutrient and pest management input costs. These reductions in costs can only be captured in a long-term study. This would also allow the yielding of full benefits from investments made in early years of an organic system (biological pest control, changes in buildings, fencing, breeding livestock, etc). Moreover, a multi-year comparison could ensure that variability in annual prices and net returns are duly taken into account.

Overall, a long-term study - covering at least three years starting after the conversion period is over - is an imperative to understand farm economics. Another important consideration is the precise definition of what is understood by one year: some authors consider the full calendar year, others include the cropping year usually covering two calendar years. If only the growing of the cash crop is accounted for, and no pre-seeding or post-harvest costs are included (e.g. cover crops, legumes, green manure), important costs (especially labour, seed and machinery) and benefits (erosion control, weed, pest and disease management) are disregarded.

3.10. How is family labour accounted for?

Labour costs can be counted as numbers of full-time equivalent (FTE) or in terms of hours. Hanson et al. (1997) proved that in organic systems, greater amounts of family labour was needed. Wynen (2001) showed that in both production systems, family labour (which is not a cash cost) is actually three quarters of total labour costs. Small farms are usually having higher labour use and requirements per hectare than larger organic enterprises (Lampkin and Padel, 1994).

Labour costs can be measured in several ways depending on the farmers’ (and researchers’) perception of the value of their own work on farm. If the farmer views his/her time spent on the farm in terms of opportunity costs, labour costs tend to be higher in organic. If the farmer does not view off-farm income (i.e. income earned outside the farm) as an alternative source of income, labour costs between the two systems are similar (RUTGERS, 2008). Both family and hired labour are accounted for in most studies in developed countries, whereas in developing countries, opportunity costs for family labour is omitted. In the European studies evaluated by Offermann and Nieberg (2000), labour use on organic farms was higher (10-20 percent) than on comparable conventional farms, but its extent was strongly dependent on the farm type.
Higher labour costs due to higher wages

Labour costs can be high also because of higher wage costs, not necessarily due to more labour need. Delate et al. (2002) used three different hourly rates to cover a typical range of Iowa farmers, and the authors found that increasing labour charges did not change the significantly higher net returns of organic corn and soybeans. In the German (BMELF, 1994) and Swiss (FAT, 1993) studies, organic wage costs were two to four times as high as conventional.

Further questions arise when deciding upon the inclusion of the time spent in marketing and seed selection with labour hours of the farmer, and of his/her off-farm labour. The FAT (1993) investigations proved that organic farms received higher off-farm income, which made their total net income closer to that of conventional farms.

3.11. How are loans dealt with?

Farmers often take short or long-term loans to pay for supplies, labour and purchased inputs. To account for these, it is suggested that interest on operation capital is included as a cost of production, charged on total variable costs at a rate of, for example, 10 percent per annum. For annual crops, interest can be calculated for the growing period till the harvest, and for perennial crops, for the full year (RUTGERS, 2008).

Conventional farmers are usually more indebted

Most studies did not evaluate the debt issue and thus did not take previous investments in agriculture into account. Some authors, however, noted that conventional farmers were significantly more indebted, especially in developing countries (Eyhorn et al., 2005; Shah et al., 2005; Jalees, 2008). Eyhorn et al. (2005) noted that most conventional cotton farmers in Central India bought inputs on loan, at annual interest rates between 10-15 percent (from cooperative societies) to over 30 percent (from private money lenders). Since production costs were usually lower, the necessity in organic agriculture to take up loans was far less. As Jalees (2008) indicated, the main cause for India’s extremely high farmers’ suicide rate is debt servicing for start-up costs, mainly GM seeds and chemical inputs.

3.12. What agro-climatic areas and what crops are studied?

Climatic characteristics can be crucial determinants of relative profitability. Production costs vary greatly by region, climate and production system. Studies showed that in wetter areas (e.g. Corn Belt) conventional is outperforming organic, whereas in drier areas, it is the opposite. Organic systems have been proven to be more competitive in drier areas of U.S.A. (Diebel et al., 1995).

Organic production may be a good option for areas with low disease and pest pressure, but it is much more difficult in other areas where productions costs are too high. For instance, feed costs are much higher especially for organic farms in some areas (e.g. New England) than in others (e.g. Corn Belt) where the price of organic grain increases the farther one moves away from the Corn Belt. Consequently, the financial performance of an organic dairy farm in Wisconsin looks very different from that of a New England farm where higher cost of paid labour and purchased feed nullified much of the milk price advantage (Kriegl, 2006). Thus, it is very important to consider which climatic areas are selected and what crops are grown there.

3.13. Are livestock operations included?

There are very scare financial data on livestock farms. Most studies excluded livestock operations, even if they were present in both farming systems; others included only the manure but excluded all other aspects (Helmers et al., 1986; Wynen, 2001; Chase et al., 2008). This creates an unrealistic

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3 Wynen (2001) argued that she excluded livestock operations in the comparison because sheep may be used either for wool or for fat lambs, both of which should be treated as different enterprises, and also because different classes of wool get different prices.
picture, since livestock is a crucial element for optimum economic performance of organic farms. When analyzing whole-farm performance, livestock has a crucial importance in within-farms transfers of nutrients and energy in organic agriculture. For instance, organic alfalfa grown in the rotation may be fed to animals instead of being sold on the market for premium if possible and this would immediately change the input and output calculations.

Many studies using data from non-operational farms assume that all manure inputs have to be purchased from off-farm sources (e.g. Clark et al., 1997). Dabbert and Madden (1986) found that it was more profitable to seed the crops and purchase the manure than to feed the crops to beef in a fattening enterprise. Chase et al. (2008) included manure as available source, yet other aspects of livestock operations were left out. Smolik et al. (1995) assumed that all grain was sold on the market and not fed to livestock, although rotations patterned mixed farms in South Dakota. In the Swiss investigations (FAT, 1993), gross margins were calculated separately for livestock operations - instead of calculating the gross margin for the whole mixed farm - without taking into account neither the cereal production for feed, nor the import of feed (only concentrates). Organic feeding practices are significantly more expensive than conventional practices. For all these reasons, assumptions on the source and cost of manure and feed have a dramatic effect on the outcome of economic comparisons. In comparative dairy studies in North America, higher costs of feed were the largest and most important difference between organic and conventional farms (Kriegl, 2006).

Studies with livestock have to be more cautious when determining whether feed and compost is bought or produced on-farm, because they may lead to contrasting economic results. Another question that can influence the profitability of livestock operations is whether gross margins or net returns are calculated per animal or per kg/liter base (which can be higher in organic) or per hectare base (which can be lower due to lower stocking rates in organic farms). Where quotas are limiting, the margin per liter produced is a more relevant performance measure.

3.14. Are processing and transaction costs taken into account?

Calculating processing costs is not straightforward, as many crops can be sold in processed or unprocessed form. For instance, cocoa beans can be sold as fermented or unfermented. Coffee beans can be sold in raw form, as pulped and not dried, and as pulped and dried (parchment). Organic farming scheme operators usually purchase fermented cocoa and fully dried coffee beans (Gibbon and Bolwig, 2007). However, the picture gets more complicated since not all produce can be sold as fermented or dried.

<table>
<thead>
<tr>
<th>Example of higher processing costs in organic</th>
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<tr>
<td>On average, in a study in Uganda, organic cocoa farmers sold 57 percent of their crop as organic, 24 percent in fermented form as conventional and 18 percent in unfermented form. Similarly, conventional cocoa farmers sold 58 percent of their crop fermented, and 42 percent in unfermented (Gibbon and Bolwig, 2007). The same study found that the higher costs of coffee processing in case of organic can be explained by the fact that a higher level of processing was required for organic coffee.</td>
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</table>

Transactions costs are associated with the marketing and delivery of products from the farm to the customer. These include post-harvest handling, packaging and storage, labour to sell, invoice and delivery of product. Chase et al. (2008) advised to make a separate transaction cost report as a companion for each enterprise budget. Since production costs do not vary by marketing outlet, he suggested to evaluate marketing decisions separately. By contrast, the New Jersey Agricultural Experiment Station advises marketing costs to be included as a cost of production. Farmers usually sell products through a third party, an auction or a broker, for which a selling charge has to be paid. If however, farmers are contracted to an organization (as are organic farmers) or to a processor, no selling charges are included in the budget.

On top of processing and transaction costs, wastage accounts for another important element that influences returns: especially in case of fresh vegetables and fruits, a high percentage of harvest may
be lost for different reasons (e.g. bad storage, weather). Economic studies do not specify explicitly the amount of harvest that is wasted and thus not sold, although it would be useful to know how much potential there is to reduce wastage and thus, increase profitability.

3.15. How are the different levels of farmers’ experience captured?

Many studies conclude that it is not the difference of systems between organic and conventional that determines profitability, but the difference in management experiences. Fowler (1999) noted that technical knowledge and management ability were obvious in the best performing farms. Paine (2003) also confirmed that the highest profit farmers had the strongest management skills. To thoroughly account for farmers’ experience, one could compare the best third (e.g. in terms of revenues per year) of the conventional producers of a certain operation (e.g. dairy farming) and the best third of the organic farmers, similarly the medium third and the worst third from a large sample base.

Good management enhances returns

Zentner et al. (2002) found in Canada that including oilseed and pulse crops in the organic rotation with cereals contributed to higher and more stable net farm income in most soil-climatic regions. The Glenlea long-term rotation study in Canada showed that yield loss due to organic management can be reduced by using a combined grain-forage rotation (Entz et al., 2005). Yield reduction averaged 63 percent in the organic system for the grain rotation (wheat-pulse-wheat-flax), 46 percent for the green manure rotation (wheat-red clover-wheat-flax) and 14 percent for the integrated grain-forage rotation (wheat-alfalfa-alfalfa-flax). So choosing the right crop rotation with a combined grain-forage system is crucial for the profitability of organic wheat farms since it enhances organic production thus, increases revenues.

Management skills depend on the availability of extension and technical support, on the social network of the farmer, and on his/her experience. Collecting farm household data on managerial influences, including the number of years into farming, farm size, other crops planted, membership to organizations, reasons for farming methods used, business goals and skills and management ability could capture this important aspect. Most studies done in developing countries collect household data in order to help explaining the differences in profitability (Setboonsarng, 2008). Yet, it is quite a challenge to assess management ability objectively. For instance, Wynen (2001) asked farmers to rate their management ability, and results were included in the assessment. By its nature, only studies using data from operational farms could make use of a more qualitative assessment. Nevertheless, even these field studies could exclude managerial ability as non-system factor influencing profitability: in a study done by Delate et al. (2002), all operations were implemented by one farm manager in both systems.

Farm household data in some economic comparative studies

- Philippines: number of years into farming, land size, crops, membership to organisations, reasons for farming method, lessons learned in farming - Mendoza (2002);
- Lao: family size, land size, value of production, consumption and transportation assets, distance from farm to market - Setboonsarng (2008);
- Australia: age, number of years into farming (and organic farming), self-rating and of neighbours on ability to manage farm, land size, area cropped as percentage of arable area - Wynen (2001).

3.16. How is price determined?

Some studies use farm-gate prices, others use prices received by the elevator (storage building for grains) source or wholesale through larger outlets. Farm-gate prices are obtained from local or regional buyers at the time of harvest. Profitability is very much determined by the type of market channel where products are sold (prices realized via direct marketing to the consumer often being twice as high as those received from wholesalers) and the timing of sale. Which market is more profitable is dependent upon the competition, the customer and costs. Farmers may receive higher prices in farmers’ markets than, for example, in institutional markets, but whether it would be
profitable depends on how transaction costs change. However, one may receive higher prices at a certain marketing channel (e.g. direct marketing), but if the amounts that can be sold there are limited, the overall contribution of these sales to the total revenues is modest.

**Marketing effects on profitability**

A study made on social impacts of technical innovations confirmed (Shah et al., 2005) that the right timing of cotton sales proved to be a crucial variable in the crop economics for a farmer. The price of cotton is at its peak when the harvest of pre-monsoon cotton takes place and the lowest when the monsoon cotton is harvested. Shah et al. (2005) showed that an organic farmer can receive up to 30 percent higher price when selling the pre-monsoon cotton, as compared to conventional farmers selling their monsoon cotton.

Due to price variations, several studies undertook a sensitivity analysis to determine the effects that this may have in terms of variations in profitability (Diebel et al., 1995; Smolik et al., 1995). Although prices for organic are much higher than conventional, a significant portion of organic products are sold on the conventional market. Obviously, prices and premiums should refer to the actual year when production costs have been studied and should not be used for retrospective analysis of previous years (e.g. the farm models carried out by Repstad and Eltun (1997) used production data from 1990 to 1996 in Eastern Norway, but the prices that were used for organic products were from 1996).

### 3.17. Are certification costs included?

For organic farmers, certification is an important additional cost items, yet the majority of the economic studies did not specify whether they accounted for these costs. Certification costs vary according to the fees of inspection and certification, individual or group certification, farm size, location, volume of production and the product itself. One of the major constraints of organic agriculture in developing countries is the high cost of certification, especially for smallholders and isolated locations, because of high inspection costs, when available. High certification fees (especially when foreign inspectors are flying long distances) and training costs represent for small producers a huge barrier to entry in the organic market. Contract farming and internal control systems are practical solution for small growers, since these schemes provide for shared group services and thus, reduced fees (Gibbon and Bolwig, 2007).

Small farms are often charged a much higher percentage (according to a U.S.A study, about six times more) of their annual sales for certification than very large farms (Ferguson, 2004). In many countries (e.g. UK), application fee covers certification for the holding, free technical and marketing support and a first inspection. Usually, certification costs involve both fixed and variable costs covering certification and inspection. Again, as with labour and machinery costs, different authors treat certification and associated costs differently. In the EU, certification costs are most often included among fixed costs (Padel and Zerger, 1994), though in an Africa study, Gibbon and Bolwig (2007) included cost of scheme membership among fixed costs. In gross margin calculations, treating certification and associated costs as fixed costs would mean leaving them outside of the economic evaluation.

### 4. SEEKING FAIR ECONOMIC COMPARISONS

This part of the paper will step out of the farm level to the wider level of society to highlight the wider implications of profitability. Organic agriculture faces an unfair competition in the marketplace due to the distorting effect of current subsidy schemes that favour conventional production; the unequal availability of research and extension services; and the failure to capture the real environmental, social and health externalities in market prices of conventional foods.
4.1. Government support

National or regional agricultural programmes and subsidies are mostly geared towards large-scale, chemically intensive agriculture that artificially lower the price of conventional products. Painter (1991) compared net returns of organic and conventional farms at the end of the eighties: average governmental subsidy per hectare was 38 percent higher in conventional. Authors in the nineties also found that conventional systems benefited more from governmental payments (Diebel et al., 1995; Smolik et al., 1995) than organic ones. If subsidies were expanded to support long-term aspects of agricultural productivity, such as soil-building grass and legume crops, profitability of organic farming would be much increased.

In the EU – as in most of developed countries - the financial performance of organic and conventional farming is highly influenced by the direct payment policy. The European Union introduced the agri-environmental support programme in 1994 and organic farming was one of the supported schemes (others included reduced inputs, schemes for specific habitats, etc.). Since 2000, the EU agri-environmental schemes have been integrated into the Rural Development Programme (EC Reg. 1257/1999), but the current allocation for this programme is just five percent of the total Common Agriculture Policy (CAP) budget (IFOAM, 2008). While organic farms receive considerable support from agri-environmental programmes, the design of the first pillar put organic farming at a disadvantage in the past. The 2003 CAP reform has changed this situation particularly by decoupling direct payments. Still, organic farms received 11 percent less in direct payments from the first pillar in 2004/05 (Nieberg and Kuhnert, 2007). Yet, the statistical analysis of FADN data from the years 2003/04 and 2006/07 suggests that differences in payments from the first pillar decreased, affecting positively the relative profitability of organic farms (Sanders, Offermann and Nieberg, 2008). However, according to a survey result, only 11 percent of the organic farmers think that decoupling has had a positive impact on their farm profits (Sanders, Offermann and Nieberg, 2008).

There is much debate on how inappropriate the current levels of organic support are. Nevertheless it becomes clear that a sharp redirection of public support from polluting activities to sustainable practices is necessary both in developed and developing countries, with subsidies encouraging positive externalities, combined with advisory and institutional mechanisms, legal measures and economic instruments correcting negative externalities.

4.2. Research and extension

The achievements of conventional farming system are based on several decades of intensive research and support, whereas organic research is still in its child shoes. Conventional farmers often have better access to information from extension services and university researchers. Organic farmers often need more time and greater managerial efforts to acquire the necessary knowledge of organic practices, prices, marketing opportunities, etc. Both yield levels and gross margins of rotation crops would probably increase if extension systems would also provide training and advice on managing these crops organically (Eyhorn et al., 2005). As long as no similar research and extension investments are directed into organic agriculture, yield comparisons, and consequently farm economics, can be considered unfair.

4.3. Externalities

We could only talk about the profitability of a system, when economic costs are balanced against environmental and health costs (hidden costs that society is bearing) and benefits and the outcome is still positive. At the moment, economic comparative studies only put economic inputs and outputs into the equation, and broadly overlook the environmental, social and health costs. Accounting for externalities, such as costs associated with run-off, spills, depletion of natural resources, health costs of farming exposed to pesticides, etc. are lacking. Yet organic is most often delivering public goods such as environmental and health benefits (see boxes on environmental and health impacts of organic
agriculture below). Taking the differences in external costs and benefits into account would give us the true profitability picture of the different systems.

4.3.1. Negative externalities

Environmental, social and health costs, such as off-site damage from soil erosion, pollution of surface water and groundwater, hazards to human and animal health, and damage to wildlife are all costs presently borne by society and not factored into costs of farm production (Reganold, 1992). On the health costs side, dietary exposure to pesticide residues has been linked to gastrointestinal and neurological complaints, breast milk contamination and changes in sperm quality parameters (Heaton, 2002). Organic standards on the other hand prohibit additives and ingredients such as hydrogenated fats, aspartame, artificial colourings, phosphoric acid, etc., implicated in various health concerns (Heaton, 2002).

### Example of health costs

IFAD (2005) case studies in India showed that that none of the 30 farmers interviewed in Karnataka have experienced any feelings of illness after working in the organic rice fields, whereas more than half of the conventional farmers had sometimes suffered from nausea and vomiting. In Kerala, a number of farmers were hospitalized after local groundwater was contaminated with pesticide run-off from neighbouring tea estates.

According to the World Health Organization (1992), roughly three million pesticide poisonings occur annually and result in 220 000 deaths worldwide. Both economically and in terms of human lives, these poisonings represent an enormous cost for society.

### Example of social costs

According to the National Crime Records Bureau in India, between 1997-2005, approximately 30 000 farmers committed suicide in Maharashtra, mostly in Vidarbha region. In 2007 alone, 1211 distressed farmers took their own lives in this region, where most BT cotton is grown, due to repeated cotton failure and indebtedness. In a study done by Jalees (2008), nearly 91 percent of the farmers growing BT cotton were indebted, whereas only 4 percent of farmers cultivating organic cotton had debts.

The World Resources Institute reported that after accounting for all the external costs of soil loss, water contamination, and environmental degradation caused by conventional farming practices, the average farm showed a net loss, instead of a net profit. A study carried out by Pretty et al. (2000) went further and calculated that the total external cost to the environment and to human health of organic agriculture was much lower than for conventional agriculture.

### Examples of environmental costs

The annual external costs of UK agriculture in 1996 showed £2343 million (US$3648 million), equivalent to £208/ha (US$324/ha) of arable and permanent pasture. This was 89 percent of average net farm income for 1996. Significant costs arose from contamination of drinking water with pesticides, nitrate and phosphate, from damage to wildlife, habitats, hedgerows, from emissions of gases, from soil erosion and organic carbon losses, from food poisoning, and from BSE (Pretty et al., 2000). Another study calculating the external costs of agriculture in U.S.A (including damage to water sources, to soil and air resources, to wildlife and ecosystem biodiversity and to human health) estimated to be at $5.7-16.9 billion annually, per cropland hectare at US$29-96 (Tegtmeier and Duffy, 2004). These studies only estimated externalities that gave rise to financial costs, thus they were likely to underestimate the total negative impacts of chemical-intensive agriculture.
4.3.2. Positive externalities

Organic methods offer considerable benefits in environmental, social and health aspects, including landscape and aesthetic value, recreation, nutrient recycling and fixation, soil formation, storm protection and flood control and carbon sequestration. Organic farms rely less heavily on purchased inputs and external energy, suffer less from soil loss, contain more organic matter, protect biodiversity, offer greater rural employment and more superior food in terms of food safety and nutritional content.

Positive health impacts of organic food

- Several studies indicate that 10-60 percent more healthy fatty acids (like CLA’s) and omega-3 fatty acids occur in organic dairy (e.g. Butler et al., 2008);
- In crops, vitamin C ranges 5-90 percent more and secondary metabolites 10-50 percent more in organic. Also, less residues of pesticides and antibiotics are present (Huber and van de Vijver, 2009);
- Organic food contains higher minerals and dry matter and 10-50 percent higher phytonutrients (Heaton, 2002);
- Decreased cell proliferation of cancer cells was observed on extracts of organic strawberries (Olsson, 2006);
- The Parsifal study showed 30 percent less eczema and allergy complaints and less bodyweight among 14 000 children fed with organic and biodynamic food in five EU countries (Alfven, 2005);
- In animals, organic feed leads to increased fertility (Staiger, 1988) and increased immune parameters (Finamore, 2004).

If yield comparisons would take into account the quality of the target crop - e.g. dry matter content in fresh organic produce has been shown to be higher (Woese et al., 1997) - this could compensate for lower total yields in organic agriculture in developed countries. When comparing relative yield and composition of vegetables during 12 years, Lampkin (1990) showed that although conventional yielded 24 percent more, organic had 28 percent higher dry matter in its produce.

Subsidies are one way of helping organic farmers in continuing environmentally-friendly farming. However, price supports may actually take the form of compensation for rewarding farmers for the ecosystem and societal services (e.g. landscape) they are doing for the common good. Both external costs and benefits can be quantified in economic terms (e.g. pollution abatement costs) and thus, could be taken into account in comparative studies. This would mean a redirection of economic thinking, but it would enhance the realization of the true cost of farming practices and hopefully, trigger the re-formulation of policies so that they no longer support polluting activities but those that provide the correction of negative externalities to the highest extent possible.

Positive environmental impacts of organic agriculture

- **Increased soil fertility**: biodynamic farms had better soil quality: greater in organic matter, content and microbial activity, more earthworms, better soil structure, lower bulk density, easier penetrability, and thicker topsoil (Reganold et al., 1993); agricultural productivity doubled with soil fertility techniques: compost application and introduction of leguminous plants into the crop sequence (Dobbs and Smolik, 1996; Drinkwater, 1998; Edwards, 2007);
- **More energy efficiency**: growing organic rice was four times more energy efficient than the conventional method (Mendoza, 2002); organic agriculture reduces energy requirements for production systems by 25 to 50 percent compared to conventional chemical-based agriculture (Niggli et al., 2009);
- **Carbon sequestration**: German organic farms annually sequester 402 kg Carbon/ha, while conventional farms had losses of 202 kg (Clark et al., 1999; Küstermann et al., 2008; Niggli et al., 2009);
- **Less water pollution**: in conventional farms, 60 percent more nitrate are leached into groundwater over a 5-year period (Drinkwater, 1998);
- **More water capture**: enhanced organic soil structure reduces risk of floods (Lotter et al., 2003);
- **Increased soil fauna**: organic soil fauna increases by 148 percent (Dumaresq and Greene, 2001);
- **Enhanced biodiversity**: organic farms’ biodiversity increases resilience to climate change and weather unpredictability (Niggli et al., 2008);
- **Reduced erosion**: organic agriculture reduces erosion caused by wind and water as well as by overgrazing at a rate of 10 million hectare annually (Pimentel et al., 1995).
5. CONCLUSION

Generally it is hard to conclude that one system is more profitable than the other – it depends on site and crop specific factors, availability of marketing opportunities, labour availability, agronomic factors, etc. Several variables could impact overall farm performance, thus a multi-disciplinary approach that involves the whole farm (with livestock operations if there are) and takes into account the management skills and objectives of the farmers is a more favourable option.

Dozens of studies have been analyzed in terms of their research on farm profitability, and though methodological differences prevent us from comparing them systematically, the similarities between the studies from many countries and contexts allow us to draw some general conclusions.

Profitability certainly depends on the crop choice, which of course is determined partly by environmental conditions and partly by the demand for products and available governmental programmes supporting those crops. Selection of the comparison group seems to have a strong influence on profitability. Farm size, farm type, location are all important factors in selecting the suitable candidate farms for a comparison. The availability of price premiums seem to be a crucial factor in good economic performances of organic systems and in most cases, make organic farms more profitable.

However, as at least a dozen studies showed that price premiums are not always necessary for organic systems to be more profitable than conventional systems. If higher prices are not available to compensate for the organic yield loss, than financial profitability depends entirely on achieving cost reductions. Overall, the complied data suggest that organic agriculture is economically more profitable, and even though yields decrease in developed countries, higher premiums and lower production costs compensate for these losses.

Increased profitability of organic agriculture very much depends on consumer demand, market prices and the availability of premiums. One of the biggest potentials to further improve the profitability of organic farms in developing countries lies in establishing organic markets for staple crops (organic soybeans, wheat, chilies, etc) that are part of the rotation; if these crops could be sold with a premium price, incomes of organic farms would further increase. In developed countries, premiums are most often available, so besides the market prices which farmers are unable to influence, the further reduction of production costs (energy, fuel, feed) and the use of better varieties (in terms of resistance, yield, etc.) could result in an increase of relative profitability in organic farms.

Still to date, organic agriculture faces an unfair competition in the marketplace due to: the current subsidy schemes that favour conventional production; the unequal availability of research and extension services; and the failure to capture the real environmental, social and health externalities in market prices of conventional foods. Besides directing much more research and extension investments into organic agriculture and shifting the bulk of public support from polluting activities to sustainable practices to give an equal footing to profitability studies, such studies need to take the differences in external costs and benefits into account to capture the real and multiple profits of agriculture.
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<td>1988-97 10 yrs</td>
<td>Iowa State University, Northeast Research Centre experimental comparison trials</td>
<td>Duffy M., Department of Agricultural Economics, Iowa State university. Quoted: Welsh R., 1999. The Economics of Organic Grain and Soybean Production in the Midwestern United States. Greenbelt, MD: Henry A. Wallace Institute for Alternative Agriculture.</td>
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<td>U.S.A.</td>
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<td>1986-92 7 yrs</td>
<td>Iowa State University, rotation 2 at Neely-Kinyon Research Farms</td>
<td>Chase et al., 2008. Economic Analysis of Three Iowa Rotations. ISU Extension PMR 1001. at <a href="http://www.extension.iastate.edu/Publications/PMR1001.pdf">http://www.extension.iastate.edu/Publications/PMR1001.pdf</a></td>
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<td>Germany</td>
<td>Higher gross margins (102-126% that of CV) in all years for different farm types.</td>
<td>In 1995-97, total costs in OA are lower, fixed costs are equal but variable costs are lower.</td>
<td>BMELF, 1991-1998. Agrarbericht. Bonn: Bundesministerium für Ernährung, Landwirtschaft und Forsten.</td>
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<tr>
<td>Arable and grazing livestock farms</td>
<td>Germany</td>
<td>Premium prices are necessary to achieve similar or higher profits. OA profits 124-168% that of comparable CV per ha for different farm types.</td>
<td>Lower yields for organic cereals and milk.</td>
<td>Nieberg H., 1997. Produktionstechnische und wirtschaftliche Folgen der Umstellung auf ökologischen Landbau - empirische Ergebnisse aus fünf Jahren ökonomischer Begleitforschung zum Extensivierungsprogramm, Braunschweig: Bundesforschungsanstalt für Landwirtschaft, Institut für Betriebswirtschaft, Arbeitsbericht 1/97.</td>
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<tr>
<td>Arable and grazing livestock farms</td>
<td>Germany</td>
<td>Organic farms had on average a 60% higher profit than the conventional reference group. First year organic profits were 191%, second year 161% of that of CV profits per ha.</td>
<td>-</td>
<td>Nieberg H., 1999. Produktionstechnische und wirtschaftliche Folgen der Umstellung auf ökologischen Landbau - erste Ergebnisse der Langzeitanalyse, Braunschweig: Bundesforschungsanstalt für Landwirtschaft, Institut für Betriebswirtschaft, Agrarstruktur und ländliche Räume.</td>
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<tr>
<td>Mixed farms</td>
<td>Italy</td>
<td>Organic profits were 75% that of the regional conventional average.</td>
<td>Much higher costs in OA due to four times higher fixed costs.</td>
<td>Santucci F. M. and Chiiori M., 1996. Economia delle produzioni biologiche: il caso dell'Umbria. Perugia: Università degli Studi di Perugia. Quaderni dell'Istituto di Economia e Politica Agraria di Perugia - nr. 19.</td>
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<tr>
<td>Rice</td>
<td>Philippines</td>
<td>Incomes 48% higher than CV in ‘grain equivalent’ terms. - 12% less in OA. 2000</td>
<td>Interviews with 99 farmers</td>
<td>Carpenter D., 2003. An investigation into the transition from technological to ecological rice farming among resource poor farmers from the Philippine island of Bohol, Agriculture and Human Values, Vol. 20: 165-176</td>
</tr>
<tr>
<td>Rice</td>
<td>Philippines</td>
<td>OA 70% more productive than CV. Lowest costs in OA. 38% higher yield under favourable (dry season), and 60% higher under less favourable (wet season) conditions in OA. 1998-2000 2 yrs with 4 cropping seasons 23 farmer interviews</td>
<td>Regression model based on household survey covering 585 farms</td>
<td>Mendoza T.C., 2002. Comparative productivity, profitability and energy use: intensity and efficiency of organic, LEISA and conventional rice production in the Philippines. Proceedings of the 14th IFOAM Organic World Congress, “Cultivating Communities”, Victoria Conference Centre, Canada, 21-24 August 2002.</td>
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<tr>
<td>Tea</td>
<td>India, China</td>
<td>With premium OA three times more profitable in India. Double for OA (due to labour). OA yields 30% less in India, in China by 4th year yields equalized. 4 yrs (including conversion)</td>
<td>Case studies</td>
<td>IFAD, 2005. Organic Agriculture and Poverty Reduction in Asia: China and India Focus. Report No. 1664</td>
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<td>Cotton</td>
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<td>Country</td>
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<td>India</td>
<td>Organic systems, primarily because of price premiums, more profitable.</td>
<td>2002-03</td>
<td>2 yrs</td>
<td>IFAD, 2005. Organic Agriculture and Poverty Reduction in Asia: China and India Focus. Report No. 1664</td>
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